

What is claimed is:

1. A polymeric electrolyte comprising a cross-linked polyether urethane prepared by reacting a pre-polymer having a polyethylene oxide backbone and terminated with NCO, with a cross-linking agent, an organic solvent and a lithium salt.
2. The polymeric electrolyte according to claim 1, wherein the pre-polymer is obtained by reacting isocyanate with a glycol selected from the group consisting of polyethylene glycol, polypropylene glycol and a combination thereof.
3. The polymeric electrolyte according to claim 2, wherein the isocyanate is at least one selected from the group consisting of tolylene 2,4-diisocyanate, tolylene 2,6-diisocyanate, diphenylmethane 4,4'- diisocyanate, hexamethylene diisocyanate, diphenylmethane diisocyanate, isophorone diisocyanate, triphenylmethane diisocyanate, tris-(isocyanatephenyl) thiophosphate, lysine ester triisocyanate, 1,8-diisocyanate-4-isocyanatemethylolcartane, undecane 1,6,11-triisocyanate, hexamethylene 1,3,6-trisisocyanate and bicycloheptane triisocyanate.
4. The polymeric electrolyte according to claim 1, wherein the cross-linking agent is at least one selected from the group consisting of glycerol ethoxylate, glycerol propoxylate, 3-methyl-1,3,5-pentanetriol and caprolactone.
5. The polymeric electrolyte according to claim 1, wherein the lithium salt is at least one selected from the group consisting of lithium perchlorate (LiClO_4), lithium tetrafluoroborate (LiBF_4), lithium hexafluorophosphate (LiPF_6), lithium trifluoromethanesulfonate (LiCF_3SO_3) and lithium bistrifluoromethanesulfonyl amide ($\text{LiN}(\text{CF}_3\text{SO}_2)_2$).
6. The polymeric electrolyte according to claim 1, wherein the organic solvent is at least one solvent selected from the group consisting of propylene carbonate, ethylene carbonate, dimethyl carbonate, methylethyl carbonate, diethyl carbonate and vinylene carbonate.
7. The polymeric electrolyte according to claim 1, wherein a total weight of the organic solvent and the lithium salt is 3 to 30 times that of the pre-polymer.

8. The polymeric electrolyte according to claim 7, wherein a concentration of the lithium salt in the cross-linked polyether urethane is 0.5 to 2M.

9. A method of preparing a cross-linked polyether polymeric electrolyte comprising :

mixing a pre-polymer having a polyethylene oxide backbone and terminated with NCO, with a cross-linking agent, an organic solvent and a lithium salt, to obtain a mixture and

cross-linking the mixture.

10. The method according to claim 9, wherein the cross-linking comprises heating the mixture at a temperature in a range from 25 to 65°C.

11. A lithium battery comprising:

a cathode;

an anode; and

a cross-linked polyether urethane polymeric electrolyte interposed between the cathode and the anode, and prepared by reacting a pre-polymer having a polyethylene oxide backbone and terminated with NCO, a cross-linking agent, an organic solvent and a lithium salt.

12. The lithium battery according to claim 11, wherein the cross-linking agent is at least one selected from the group consisting of glycerol ethoxylate, glycerol propoxylate, 3-methyl-1,3,5-pentanetriol and caprolactone.

13. The lithium battery according to claim 11, wherein the isocyanate is at least one selected from the group consisting of tolylene 2,4-diisocyanate, tolylene 2,6-diisocyanate, diphenylmethane 4,4'- diisocyanate, hexamethylene diisocyanate, diphenylmethane diisocyanate, isophorone diisocyanate, triphenylmethane diisocyanate, tris-(isocyanatophenyl) thiophosphate, lysine ester triisocyanate, 1,8-diisocyanate-4-isocyanatemethylcartane, undecane 1,6,11-triisocyanate, hexamethylene 1,3,6-trisocyanate and bicycloheptane triisocyanate.

14. The lithium battery according to claim 11, wherein the lithium salt is at least one selected from the group consisting of lithium perchlorate (LiClO_4), lithium tetrafluoroborate (LiBF_4), lithium hexafluorophosphate (LiPF_6), lithium

trifluoromethanesulfonate (LiCF_3SO_3) and lithium bistrifluoromethanesulfonyl amide ($\text{LiN}(\text{CF}_3\text{SO}_2)_2$).

15. The lithium battery according to claim 11, wherein the organic solvent is at least one solvent selected from the group consisting of propylene carbonate, ethylene carbonate, dimethyl carbonate, methylethyl carbonate, diethyl carbonate and vinylene carbonate.

16. The lithium battery according to claim 11, wherein the total weight of the organic solvent and lithium salt is 3 to 30 times that of the pre-polymer.

17. The lithium battery according to claim 16, wherein a concentration of the lithium salt in the cross-linked polyether urethane is 0.5 to 2M.

18. The lithium battery according to claim 11, further comprising a separator having a network structure and made of an insulating resin, between the cathode and the anode.

19. The lithium battery according to claim 11, wherein the separator is formed of one selected from the group consisting of polypropylene, polyethylene and a combination thereof.

20. A method of manufacturing a lithium battery comprising:
mixing a pre-polymer having a polyethylene oxide backbone and terminated with NCO, with a cross-linking agent, an organic solvent and a lithium salt, to obtain a mixture;
casting the mixture on a surface of at least one of a cathode and an anode so as to be between the cathode and the anode; and
cross-linking the resultant product.

21. The method according to claim 20, wherein the cross-linking comprises heating the resultant product at a temperature in a range from 25 to 65°C.

22. A method of manufacturing a lithium battery comprising:
mixing a pre-polymer having a polyethylene oxide backbone and terminated with NCO, with a cross-linking agent, an organic solvent and a lithium salt, to obtain a mixture;
interposing a separator between a cathode and an anode to form an electrode assembly and accommodating the electrode assembly into a battery case; and

injecting the mixture into the battery case having the electrode assembly and cross-linking the resultant product.

23. The method according to claim 22, wherein the separator is formed of one selected from the group consisting of polypropylene, polyethylene and a combination thereof.

24. The method according to claim 22, wherein the cross-linking comprises heating the resultant product at a temperature in a range from 25 to 65°C.

25. The lithium battery according to claim 11, wherein the cathode or the anode comprises:

- a current collector;

- an electrode active material layer formed on the current collector, the electrode active material layer comprising:

 - an electrode active material,

 - a binder,

 - a conductive agent, and

 - a solvent.

26. The method according to claim 20, further comprising:

- forming an electrode active material layer by adding an electrode active material, a binder, a conductive agent, and a solvent; and

- coating the electrode active material layer on a current collector, to obtain the cathode or the anode.

27. The method according to claim 20, further comprising:

- forming an electrode active material layer by adding an electrode active material, a binder, a conductive agent, and a solvent;

- coating the electrode active material layer on a support body;

- peeling the electrode active material from the support body; and

- laminating the peeled electrode active material on a current collector, to obtain the cathode or the anode.

28. The method according to claim 22, further comprising:

- forming an electrode active material layer by adding an electrode active material, a binder, a conductive agent, and a solvent, and

coating the electrode active material layer on a current collector, to obtain the cathode or the anode.

29. The method according to claim 22, further comprising:

forming an electrode active material layer by adding an electrode active material, a binder, a conductive agent, and a solvent;

coating the electrode active material layer on a support body;

peeling the electrode active material from the support body; and

laminating the peeled electrode active material on a current collector, to obtain the cathode or the anode.

30. A method of manufacturing a lithium battery comprising:

mixing a pre-polymer having a polyethylene oxide backbone and terminated with NCO, with a cross-linking agent, an organic solvent and a lithium salt, to obtain a mixture;

forming an electrode assembly with the cathode and the anode, and accommodating the electrode assembly into a battery case; and

injecting the mixture into the battery case having the electrode assembly and cross-linking the resultant product.